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U. S. DEPARTMENT OF AGRICULTURE.

Report No. 61.

TEA CULTURE:

THE EXPERIMENT IN SOUTH CAROLINA.

BY

DR. CHARLES U. SHEPARD,

SPECIAL AGENT IN CHARGE TEA CULTURE INVESTIGATIONS.

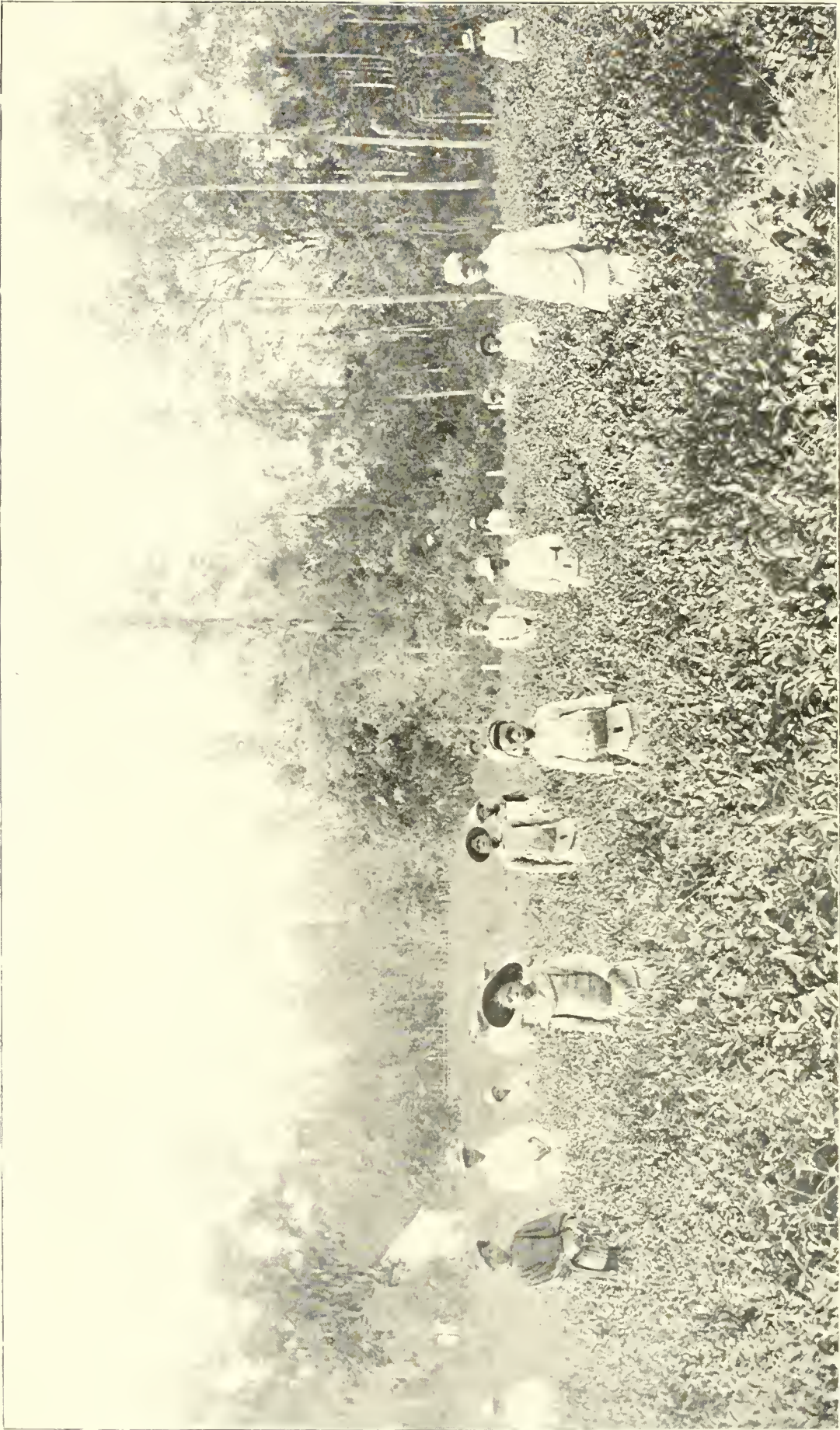


WASHINGTON:

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1899.





SOUTH FRASER TEA GARDEN, FOUR YEARS OLD, PLANTED WITH DRAGON'S POOL (CHINESE) TEA SEED.

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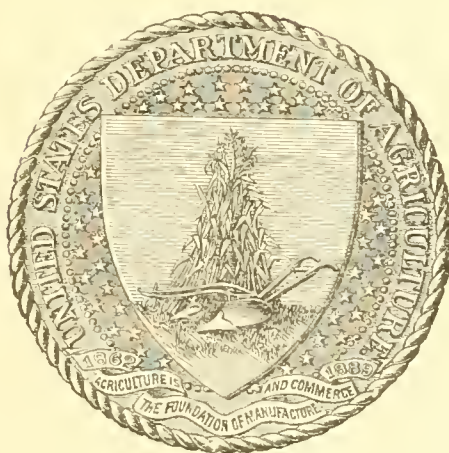
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LETTER OF TRANSMITTAL.

PINEHURST PLANTATION,
Summerville, S. C., September 15, 1899.

SIR: I have the honor to transmit herewith, in accordance with your request, a report on tea growing at this place, and to suggest that the facts be made public as the means of encouraging others to take part in the development of this industry.

Respectfully,

CHARLES U. SHEPARD,
Special Agent in Charge Tea Culture Investigations.

Hon. JAMES WILSON,
Secretary of Agriculture.

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TEA CULTURE: THE EXPERIMENT IN SOUTH CAROLINA.¹

INTRODUCTION.

The problem of raising tea in the southern part of the United States has been discussed for many years. As early as 1848 Dr. Junius Smith made a successful planting at Greenville, S. C., but the work was not continued and interest in tea culture abated. In 1881 Congress made an appropriation for an experiment in tea culture, but when Mr. William Saunders, Horticulturist and Superintendent of Gardens and Grounds of the Department of Agriculture, made an examination of the work done under it he found that owing to the illness of the expert, Mr. John Jackson, and other causes the money had been injudiciously expended and reported that there was little prospect of anything of value being accomplished. Thereupon by recommendation of Hon. George B. Loring, Commissioner of Agriculture, the experiment was closed.

In 1892 the subject was taken up again in the Annual Report in a report by the writer upon the operations on the Pinehurst estate at Summerville, S. C. In 1897 a second report upon the work there was made by Mr. Saunders. The statement now published continues the presentation of the results obtained on the Pinehurst plantation.

It seems probable from the facts so far gathered that the cultivation of tea can be made profitable in the warmer portions of the United States in two ways. One is by establishing a plantation on the scale of the experiment at Summerville, with capital sufficient to carry the work to a point where the product can be offered on equal terms with teas holding an established place in the markets of the United States. The other is to grow tea for home use in the farm garden. In either case tea growing can be undertaken safely only where the temperature rarely goes lower than 25° F. and never below zero, and where a liberal supply of water can be depended upon. There is probably no place in the United States where the rainfall is sufficient for the best results with the tea plant, and irrigation should where possible be provided for in growing tea.

The experimentation at Summerville, on the growth and manufacture of tea, began about ten years ago. At the commencement it was wisely on a small scale, but has been gradually increased until now over 50

¹This paper brings up to date the reports on the growing of tea by Dr. Charles U. Shepard at his farm "Pinehurst," Summerville, S. C. Previous statements of the progress made will be found in the Annual Report of this Department for 1892, and in Circular No. 1, Division of Gardens and Grounds, this Department.

acres have been planted in tea. When the plants arrive at full bearing, the yield should be at least 10,000 pounds of high-grade tea; and this should suffice for the object in view, viz, to determine whether commercial tea may be profitably grown under the local conditions of soil, climate, and labor.

It was desirable to conduct the experiments with as many varieties of seed and under as different conditions of soil and location as possible. To this end, by the kind assistance of the Department of Agriculture and by purchase from foreign and domestic producers, a considerable variety of seed, representing many of the choicest sorts of tea, was obtained. Gardens were established on flat and on rolling land, in drained swamps and ponds, and on sandy, clayey, loamy, and rich bottom soils.

The problem of providing labor for plucking tea leaf has been solved so far as a steady and skillful band of nimble-fingered children goes; but its price is inordinately high as compared with the Orient. It was indispensable to secure a reliable corps of pickers. To meet this condition there was built a comfortable schoolhouse and a competent teacher engaged. (Pl. VII, fig. 2.) The colored families of the neighborhood were then invited to send their children to the school free of charge. They would be taught the ordinary branches, and also would be taught to pick tea, and so earn money to buy food and clothing. The offer was accepted, and now there is a good list of pupils to draw from as pickers are required.

It was from the outset expected that many of these attempts would prove either partially or wholly unsuccessful. But being thoroughly convinced of the value of all experimental work honestly carried out and faithfully reported, the writer has not regretted the labor and expense incurred in these operations, especially as all but one (an attempt to introduce teas of too tender growth) have given at least some return and are steadily growing in yield.

GOOD SHOWING OF DRAGON'S POOL TEA.

The South Fraser tea garden makes a remarkable showing. It contains slightly more than 2 acres of tea bushes, planted at 4 by 4 feet distances. The bushes were raised from seed procured in 1892 through the kindness of the United States Agricultural and State Departments and John Fowler, esq., United States consul at Ningpo, China. It came from a celebrated garden near Hangchow, the capital of the Province of Chekiang, called Loong Tsin, meaning Dragon's Pool. Mr. Fowler wrote that the seed was of the "very best" sort and that the leaf was always made into green tea. Concerning the tea he also stated: "It has no market name, for the reason that it is not sold outside of the place of growth. It can not be bought in this port (Ningpo) nor at Shanghai. It is sun dried, and of course is not colored artificially. It is not exported; it is too dear. It costs 10 cents per ounce—\$1.60 per pound—at Hangchow. Only Chinese can afford to use it; it is too dear for Americans—i. e., those in America."

As shown in the frontispiece, this garden is remarkably thrifty. The vacancies amount to about 4 per cent only, and visitors practically acquainted with Oriental gardens have expressed themselves as surprised by its luxuriant and uniform growth, even to the extent of stating that it equaled anything they had seen in the East. The bushes are thick, of comparatively low growth, and globular form. The leaf is generally rather small and quite tender; it is well adapted for the manufacture of either green or black tea, although the weight of opinion among tea experts is that the latter product is the better of the two. The garden is mostly situated on a knoll, but a portion extends down into low moist land. The ground is clay loam, with a stiff clay subsoil. It has been heavily enriched every spring with a high-grade fertilizer at the rate recently of 600 pounds to the acre. It suffered comparatively little from the February freeze, only small patches requiring pruning back to within a few inches of the ground.

The yield of (dry) tea has been as follows:

	Pounds.
1894	83.8
1895	185.7
1896	215.9
1897	247.5
1898	307.3
1899 to September 15.....	469.1

There is every prospect that the crop of this year will exceed 500 pounds by the end of the season. It is safe to add that there are few gardens in China which yield a crop of over 200 pounds (dry) tea to the acre. It remains to be seen to what extent the output of this garden may grow.

SUCCESS OF THE ROSE TEA GARDEN.

The constant purpose and hope were to find from all of the data obtained some one way, readily accessible to all, by the employment of one or more sorts of seed and under conditions readily communicable to others, whereby tea may be profitably grown and manufactured in this section. This result seemed to have been demonstrated when the following report of the Rose tea garden was published last fall in the News and Courier, Charleston, S. C., September 15, 1898:

The site [of the "Rose Garden"] was an old piney woods pond, with a black, rich (in humus) but sour surface soil, overlying quicksand and, yet lower, clay. The ground was thoroughly subsoil drained, heavily sweetened with burnt marl and deeply plowed. About 1,000 plants of acclimated Assam-hybrid tea were set out at 6 by 6 feet, "quincunx." Whether from the slowness experienced in overcoming the original acidity of the soil or from the comparatively feeble growth of the seedlings during the first few years—in this respect resembling its relative, the camellia japonica—little progress was made from 1890, the date of the establishment of the garden, until 1894, although some leaf was plucked from it in 1892.

Again, the system of pruning practiced at the start of the experimentation, whereby clean stems were maintained, had to be abandoned after the loss of many plants and a degree of disappointment which almost caused the cessation of further work in this direction.

At present the garden contains about 800 vigorous bushes, each one composed of many stems, the result of cutting out the original main stem and inducing a luxuriant sucker growth. There are also about 200 younger plants occupying the places where older ones died; they naturally produce less leaf. Altogether, this garden of less than an acre may be fairly regarded as containing the equivalent of 900 plants in good bearing.

INCREASE OF PRODUCT.

The output of green leaf from it has been as follows: Crop of 1892, 56 pounds; crop of 1893, 81 pounds; crop of 1894, 151 pounds; crop of 1895, 333 pounds; crop of 1896, 600 pounds; crop of 1897, 648 pounds; crop of 1898, 1,000 pounds to September 1, with the prospect of reaching almost 1,200 pounds by the end of the season.

It is to be noted that there has been a material increase each year over the preceding, amounting to almost if not quite 100 per cent, with the exception of 1897, when a prolonged autumnal drought materially interfered with the leaf production. It is, of course, impossible to foretell to what limits this expansion may extend before reaching that slight annual variation which marks the maturity of the plant. But it would not be surprising if the outturn were doubled within a year or two. Twelve hundred and sixty pounds of green leaf will afford 300 pounds of standard Pinchurst black tea.

On a basis of 900 plants in the "Rose Garden," the production per bush is 5 ounces of tea. If it were a full acre the yield would approximate 400 pounds. And if the plants had been placed at shorter distances apart, as is the practice in the Orient and now at Pinchurst, the output per acre should be materially larger. The average yearly production per bush in Japan does not exceed 1 ounce; in China it is from 1 to 2 ounces; in India and Ceylon 3 to 5 ounces. In the last-named countries there are estates which annually produce over 1,000 pounds of tea to the acre; but they constitute the rare exceptions. Oriental tea gardens usually contain about 2,000 plants to the acre.

This gratifying productiveness of an experimental garden of almost an acre affords good ground for the belief that commercial tea may be grown in South Carolina in quantity quite comparable with the average yield of the most favorably situated Oriental countries. But the "Rose Garden" is not to be regarded as an exceptional result, nor of difficult imitation. Two larger gardens, also formerly piney-woods ponds, planted with Darjeeling seedlings, promise successful rivalry within a few years, and yet others appear to be awakening to a more vigorous productiveness.

COST OF PRODUCTION.

The cost of a crop of 300 pounds of tea from the "Rose Garden," by reason of its greater productiveness, is much less than that from Pinchurst as a whole, and yet it is evident that very material reductions might be secured were its area even only tenfold enlarged; much more so did it contain 100 acres. The following table shows the actual cost of the several operations in the growth, picking, and curing of the crop of 1898 in the "Rose Garden," as also the estimated and materially reduced expense for the same rate of production on a larger scale:

Items of cost.	Actual cost per pound.	Possible reduced cost per pound.
	<i>Cents.</i>	<i>Cents.</i>
Pruning	3	2
Manuring	3	2
Cultivation	1½	1
Leaf picking	14	8
Factory work	6	3
Total	27½	16

A glance at the above table shows that the chief expense is that of gathering the leaf. Experience has demonstrated that a smart lad or grown girl can pick from a good "flush" 20 pounds of green leaf in ten hours, or, say, enough to make 5 pounds of tea. This should be done for 30 cents, or at 6 cents per pound. The supervision in the field will add 1 cent. With immature plants or poor "flushes" there is necessarily much more labor to be spent, and consequently more time in securing the same amount of leaf. Again, the "fineness" of the plucking materially influences its cost. The picking of a coarser and larger leaf or two from each shoot greatly increases the yield and lessens the cost. But with medium leaf picking, and in southern localities, where labor is cheap, with an outturn of at least 400 pounds of tea to the acre, this expense should not exceed 8 cents per pound.

There remains to be considered the cost of superintendence and the fixed charges for the outlay in the establishment of the garden and its maintenance until self-supporting. As to the former, the cost will largely depend on the size of the crop; on a production of 100,000 pounds per annum it should not exceed 2 cents per pound of tea. The expense of putting the land in suitable condition for a tea garden should not exceed that for any other intensive crop. The cost of raising and setting out the tea seedlings will vary from \$25 to \$50 per acre, according to whether raised from domestic or foreign seeds. In the establishment of a large tea estate the initial expenses are necessarily heavy, but it should be borne in mind that once well done it is practically for all time. The best Japanese tea is said to be gathered from bushes two hundred years old.

QUALITY OF THE TEA.

The leaf plucked from the "Rose Garden," as indeed from the whole estate, is fine, i. e., it very rarely consists of more than the Pekoe tip and two leaves, and then only to the first Souchong. Heretofore, and without the aid of a protective duty it has been possible to sell all of the Pinehurst (black) tea at \$1 per pound retail. It remains to be seen whether the duty will be repealed now that hostilities have ceased, or, if not, what effect it will have on the price of the better grades of tea. But after all deductions—and they are not to be underrated—it must be realized that there is a wide margin of profit between the cost of 1 pound of "Rose Garden" tea if produced on a large scale, say 25 cents, and the wholesale price of an equally good imported tea, say 50 cents. A profit of 10 cents per pound means a profit of \$40 per acre on an annual production of 400 pounds of tea, and higher profits per pound, with increasing yield per acre, will rapidly swell the income.

It is now to be added that without undue endeavor the writer sold his crop of 1898, about 3,000 pounds, as also about 500 pounds of the crop of the previous year (which had been repurchased to maintain prices), altogether about 3,500 pounds, at a profit of about 25 per cent. But this simple statement fails to convey an adequate conception of the achievement. The Pinehurst black tea has a distinctly characteristic flavor, and, like some of the choicer Oriental teas, its liquor has more strength than its color indicates. These qualities render its introduction slow. But it has always proved a difficult matter to change the taste of tea consumers; notably so in the introduction of Ceylon tea into Great Britain, the mother country of its producers. Nevertheless there has been a steadily increasing demand for Pinehurst tea, and a great many people will drink no other.

SEVERE TEST OF TEA GARDEN BY COLD WEATHER.

The past winter has fortunately (for the sake of most conclusively testing the feasibility of the local cultivation of tea) subjected the

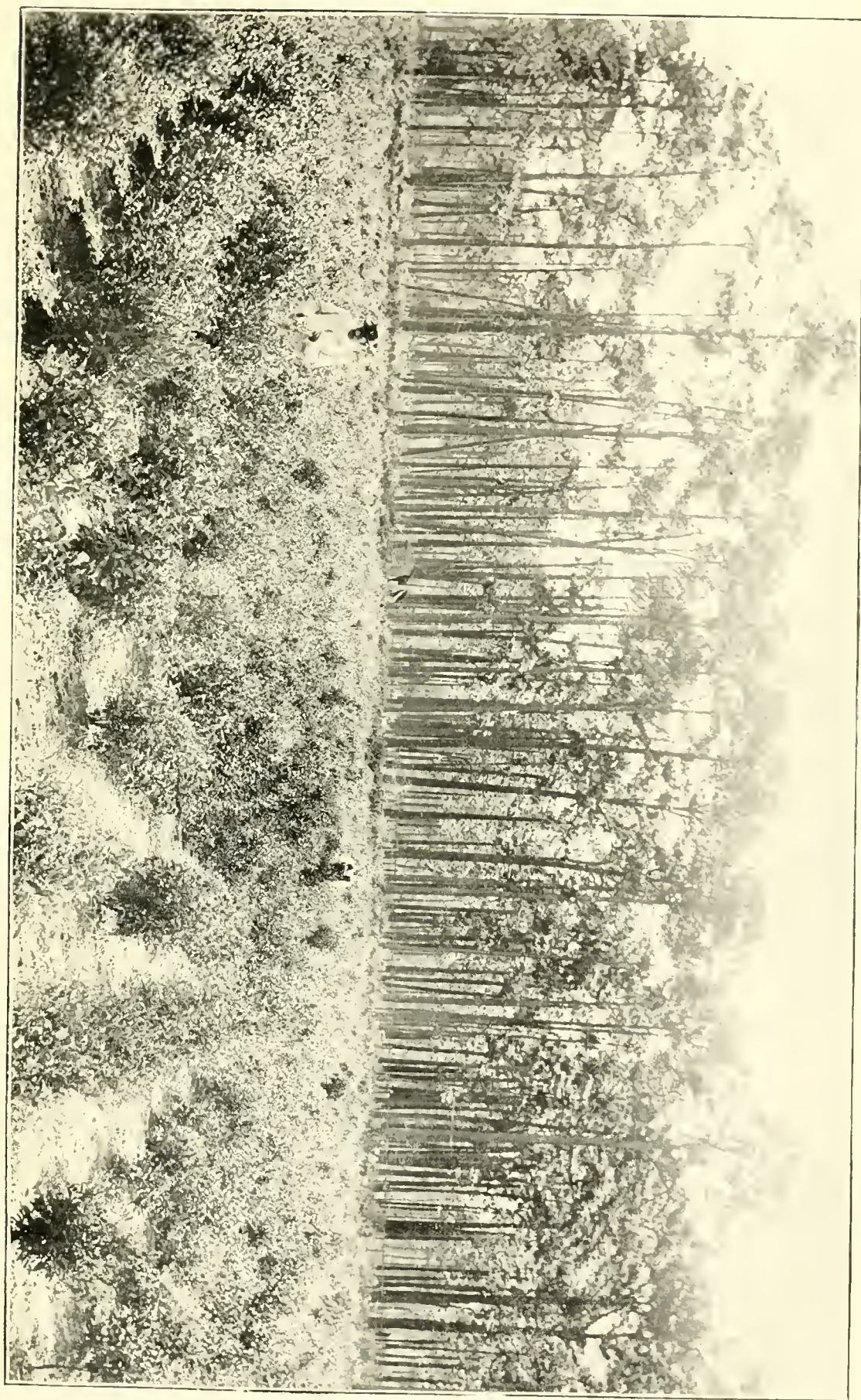
gardens to an extraordinary ordeal, viz, the greatest cold in one hundred and fifty years—the fall of the thermometer on the morning of February 14 to half a degree below zero, F. Happily this occurred when the ground was covered to the depth of 5 inches with snow. It was observed that those plants which were in the most exposed situations suffered the least, having been brought by the previous cold weather into a state of hibernation which enabled them to withstand the extreme cold, whereas those which were in sheltered positions or in the most luxuriant growth suffered greatly in all parts above the snow level. The result was, that it was found necessary to rigorously prune back to within a few inches of the ground all of the bushes in the most productive gardens, which are generally in the drained ponds, and elsewhere those individual plants which especially suffered from the cold. The accompanying illustrations (Pls. I–IV) are from photographs of two fields, taken last autumn and in April of this year, and exhibit the extreme luxuriance of their leaf production at the former time and the enforced severity of the pruning at the latter. On May 1 every clump of shorn roots—for our present system of cultivation aims to substitute a cluster of straight vigorous stems for the single clean trunk—was more or less covered with a thrifty outburst of young vegetation. This gave promise that the phenomenal freeze of 1899 would have no further ill effect than that which follows the customary low pruning every five or more years in India and Ceylon, which necessarily reduces production during the following few months, or, perhaps, entire season. Plate V, made from a photograph taken of the Rose tea garden in July of the present year, shows that our expectations have been more than realized, as the plants are fully two-thirds as large as they were at the same time last year.

The anticipation that the phenomenal cold of last winter would not materially diminish the tea crop of 1899 is being substantiated. A comparison of the yield of dry tea for the two seasons shows the effect of the previous severe winter in the diminished production of leaf in the early part of the plucking season, as also a gradually increasing yield thereafter until by the end of August the total crop exceeded that of the previous season by about 23 per cent.

Tea crop, seasons of 1898 and 1899.

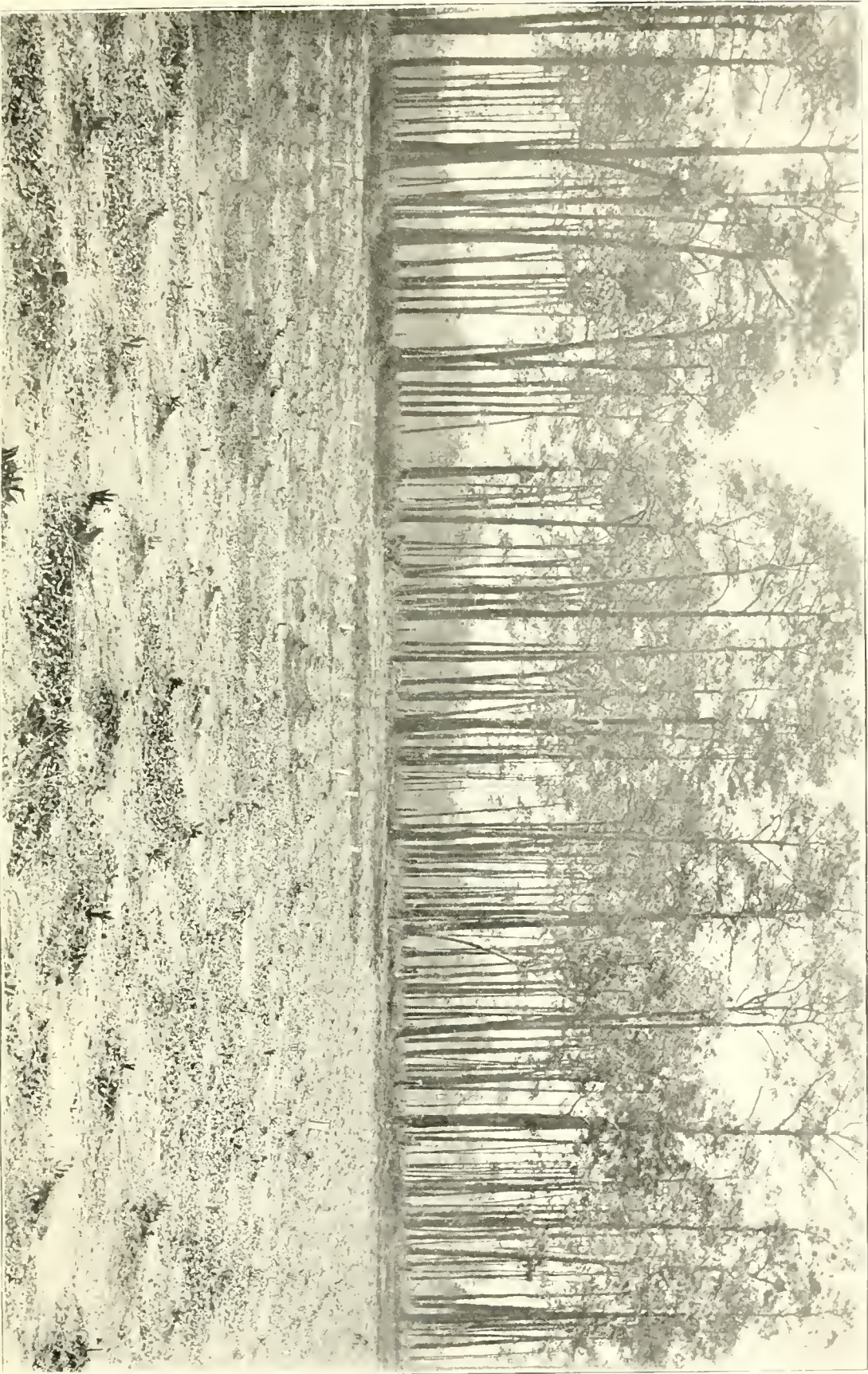
For the months of—	1898.	1899.
	<i>Pounds.</i>	<i>Pounds.</i>
April	74.6	None.
May	472.9	445.1
June	428.2	581.2
July	671.7	868.3
August	623.8	900.5
	2,271.2	2,795.1

The percentage of (apparently) seriously injured plants is small; that of killed outright yet less. At present the outlook for 1899 is

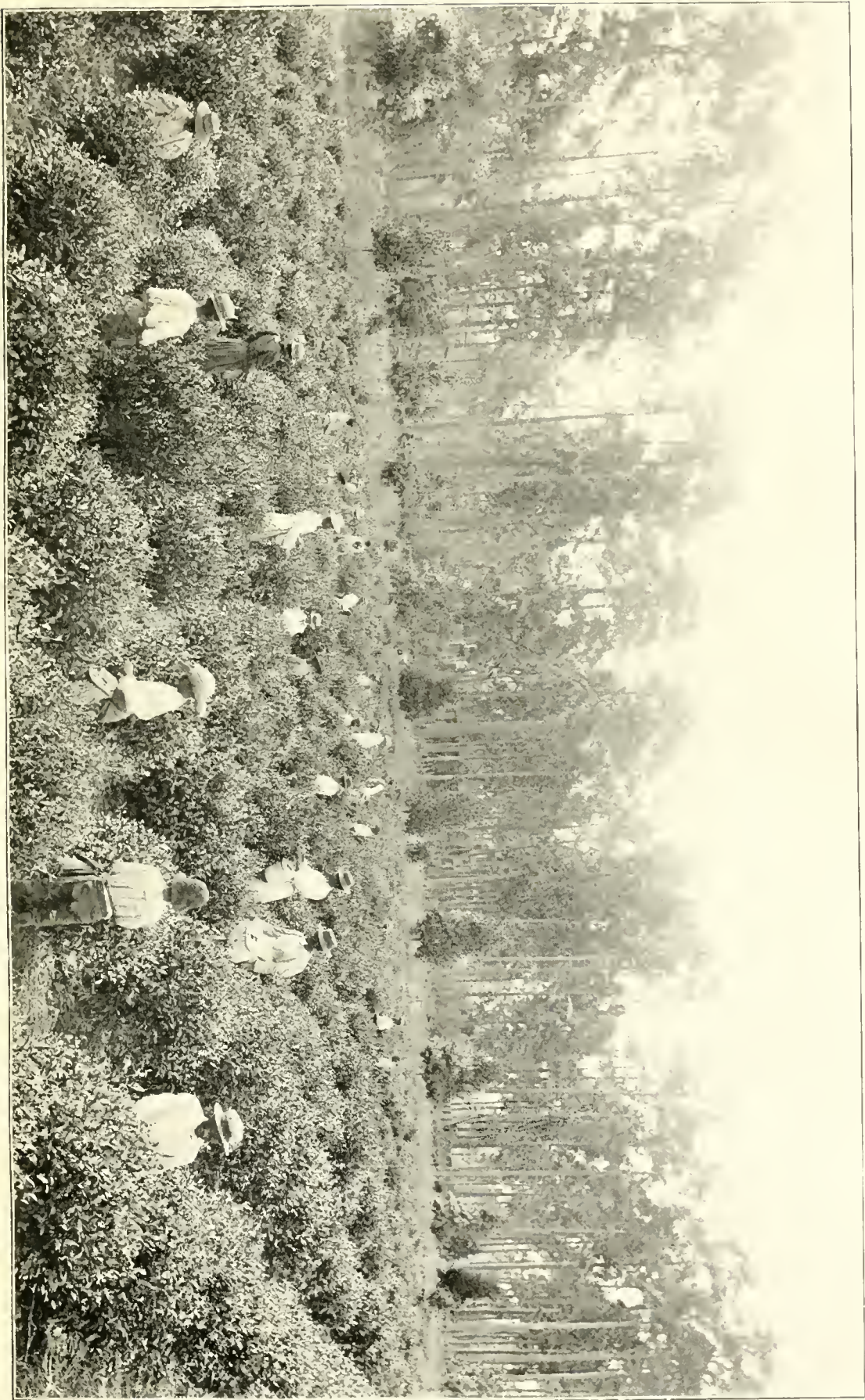


LINCOLN TEA GARDEN, AUTUMN, 1898, WHEN FOUR YEARS OLD.

Planted with Darjeeling tea seed.



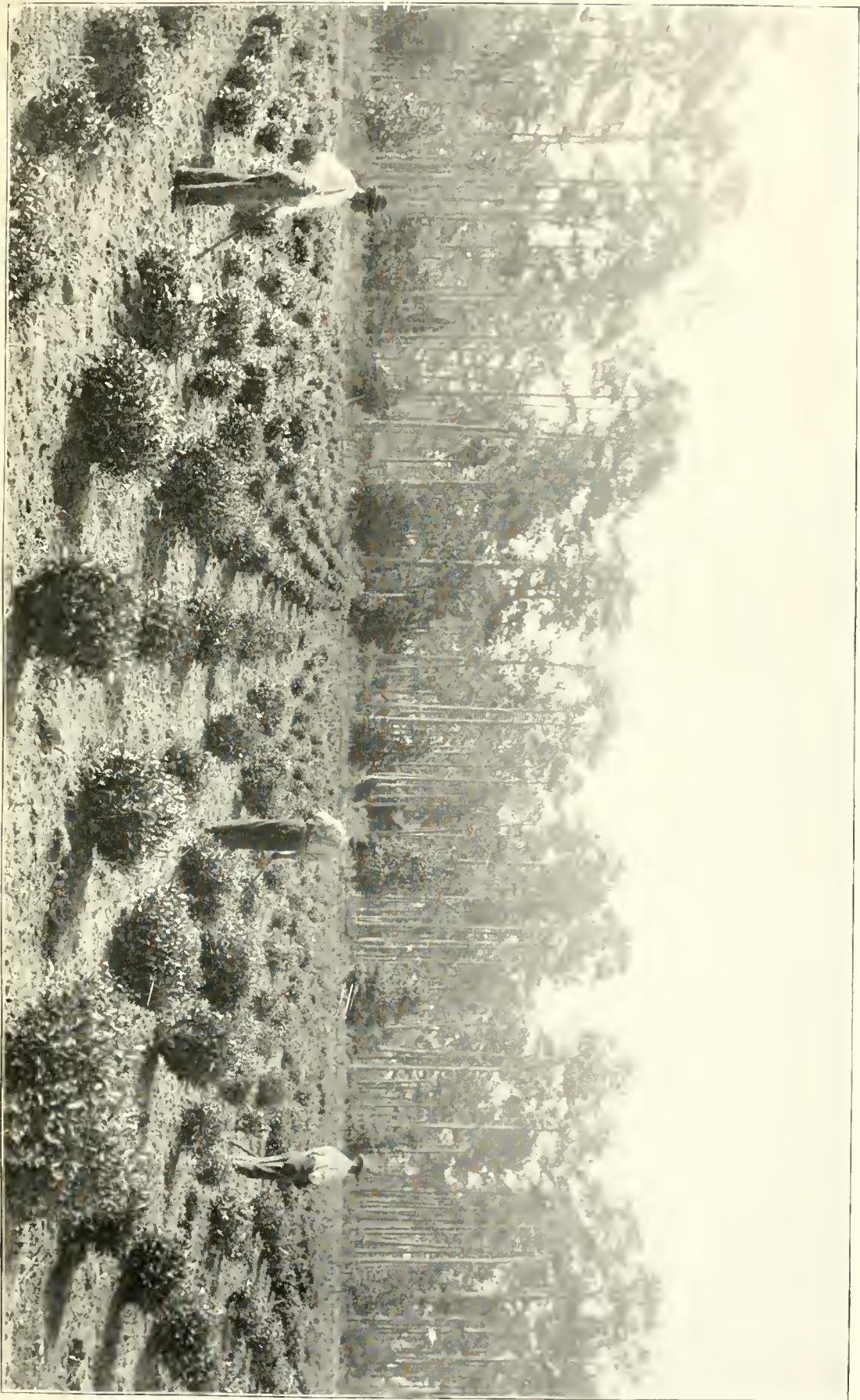
LINCOLN TEA GARDEN, APRIL, 1899, SHOWING EFFECT OF VIGOROUS PRUNING AFTER SEVERE COLD OF FEBRUARY



ROSE TEA GARDEN, AUTUMN OF 1898, PLANTED WITH ASSAM-HYBRID TEA SEED.

ROSE TEA GARDEN, APRIL, 1899, SHOWING EFFECT OF VIGOROUS PRUNING AFTER SEVERE COLD OF FEBRUARY.





ROSE TEA GARDEN, JULY, 1899, SHOWING REMARKABLE RECUPERATION.



FIG 1. ROASTING AND ROLLING GREEN TEA.



FIG. 2.—A TEA NURSERY IN JULY.

for a crop of over 3,000 pounds. The Rose and Lincoln tea gardens, which after the February freeze were pruned almost to the ground, have sufficiently recovered to afford small pluckings, judiciously made, with the promise of abundant later flushes. The bushes in the Rose garden might be better termed "clumps," so luxuriant is the outburst of shoots. They average almost 30 inches in height and 36 inches in diameter, and at a recent plucking (August 18) afforded 22 pounds of (dry) tea. There has not appeared any diminution in the strength of the finished tea.

CURING AND QUALITY OF GREEN TEA.

Considerable green tea has been made this season and it has found a fair sale. Designed to imitate the better class of teas made in the Orient and practically unknown here, it was not expected to find a ready market at the comparatively high price necessitated by its having to be manufactured wholly by hand. Plate VI, figure 1, shows the two processes of roasting the fresh leaf in an iron pot with a very thick bottom and hand rolling on a table, which are the main points in the manufacture of green tea. As yet no mechanical substitute for these combined operations has been invented. The rolled and partially dried leaf is afterwards fully dried under constant stirring and at a decreasing temperature. Thus far the mechanical apparatus erected at Pinehurst for making green tea in vacuo has failed to produce the desired results, but it is hoped that later experiments may demonstrate some advantage from this process.

Young and tender leaf from several sorts of tea plants was used in the manufacture of green tea. The best results have been obtained from Formosa leaf, but Japanese, some Chinese (notably that obtained from the celebrated "Dragon's Pool" tea estate), and Kangra varieties have yielded satisfactorily. The bushes of these sorts are smaller and the yield less than is the case with the Ceylon and Indian. The leaf is also smaller and thicker and apparently less quick to oxidize, consequently better adapted for the manufacture of green tea.

The green color of the infusion of Pinehurst green tea has attracted keen interest in the trade and among consumers. Oriental teas can hardly furnish the like in this country. The length of the transportation induces a change of color in their liquor from greenish to yellowish red. It is well to urge upon most tea drinkers that the raspiness, which many conceive to be the strength and value of a tea, is chiefly due to tannic acid and similar substances, which are deleterious rather than nerve strengthening. A tea may be rich in this last property, and yet neither exhibit much color nor provoke throat irritation nor act injuriously upon the stomach.

BUILDINGS AND MACHINERY.

A well-equipped two-story factory with a daily capacity of 50 pounds of dry, black tea has been built. It has over 2,000 square feet now

available for withering the leaf, with the possibility of almost doubling that surface. A tea-rolling machine which does work equal to that done by 15 or 20 men at hand rolling, and two hot-air drying machines fully adequate for all the needs of the place, form part of the equipment. There is also the beginning of a green-tea factory with specially designed machinery for rolling and drying leaf in vacuo, i. e., in a chamber from which the air has been pumped in order to prevent oxidization. Plates VII and VIII show several steps in the manufacture of black tea. In the farther room to the right in figure 1 of Plate VII may be seen men laden with Swiss trout baskets, which they have borne to the factory from the tea gardens where the children have filled them with tea leaf. This is not allowed to remain any great length of time in the gardens

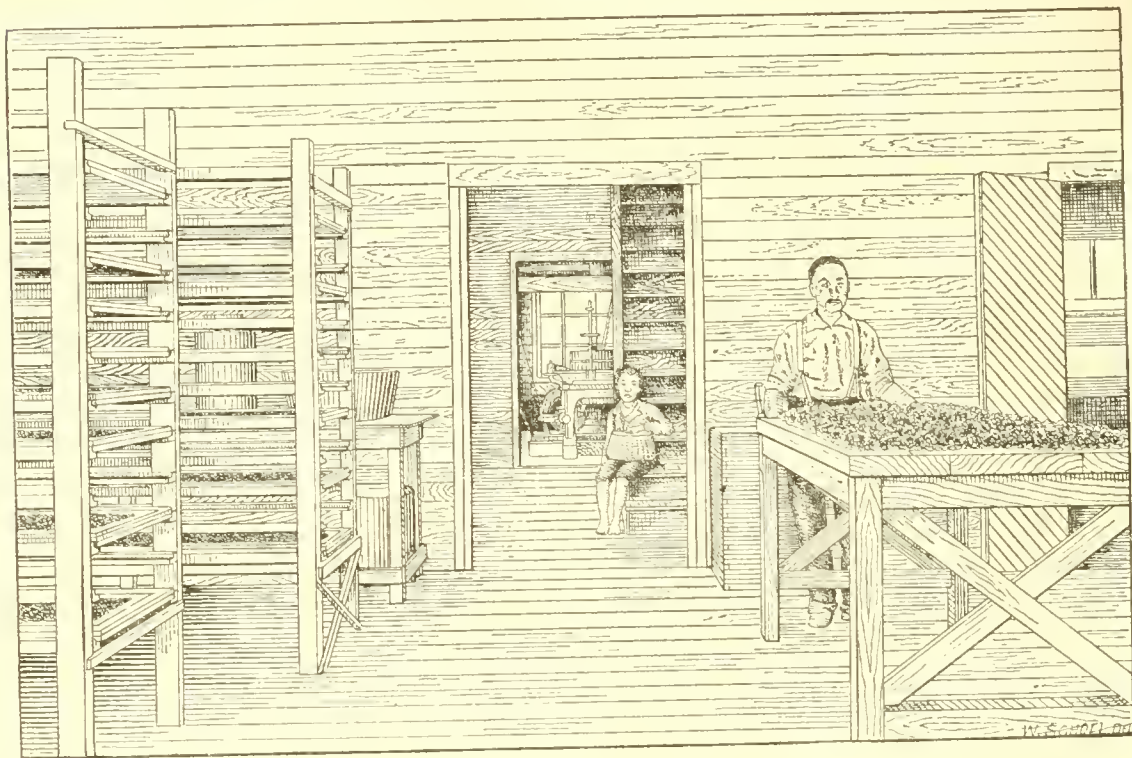


FIG. 1.—Rolling room of tea factory; “Little Giant” tea rolling machine in farthest room; in foreground, right side, roll being broken up; left side, broken roll spread on trays and exposed in frames for oxidation.

for fear lest fermentation may ensue. When brought to the factory it is carefully inspected and weighed.

It is taken upstairs to the withering lofts shown in the illustration of the upper story (Pl. VIII). Every pound of made (black) tea represents over 40 square feet of withering space. The usual output of the factory in the busy season is about 50 pounds of dry tea per diem. There is need therefore for a great deal of floor room. This is supplemented by traveling trays of cloth, shown in the illustration. They are loaded on the floor; hoisted to top of room; transferred to the running gear, by which means they may be exposed to the hot air ascending through the pit from the tea driers below, or shoved where it is cooler. They



FIG. 1.—LOWER STORY OF TEA FACTORY.



FIG. 2.—SCHOOL FOR TEA PICKERS.





FIG. 1 UPPER STORY OF TEA FACTORY.

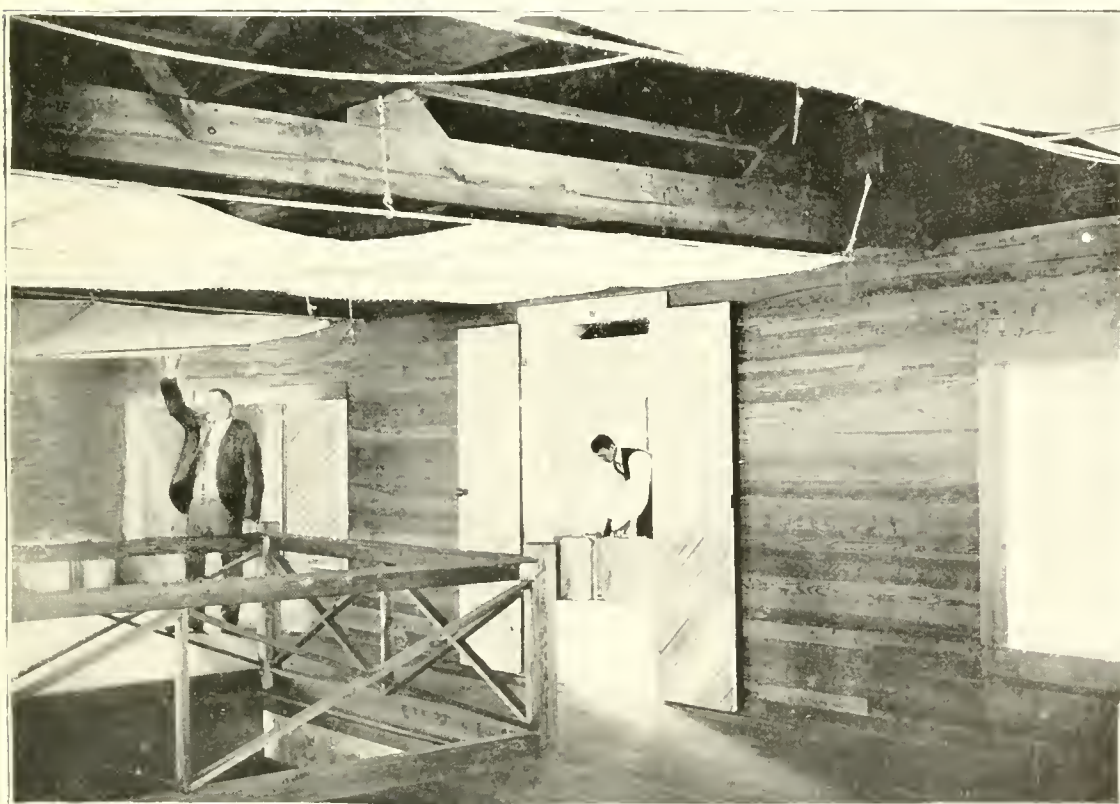


FIG. 2.—LOFTS FOR WITHERING TEA LEAF.

may be dumped where convenient when the tea has been sufficiently withered.

The tea leaf is then taken to the rolling room on the lower story (fig. 1), where it is rolled by machinery. A "Little Giant" rolling machine (fig. 2) is shown in the farther room of the lower story. After being rolled, the "roll" is brought into the room shown in the fore-

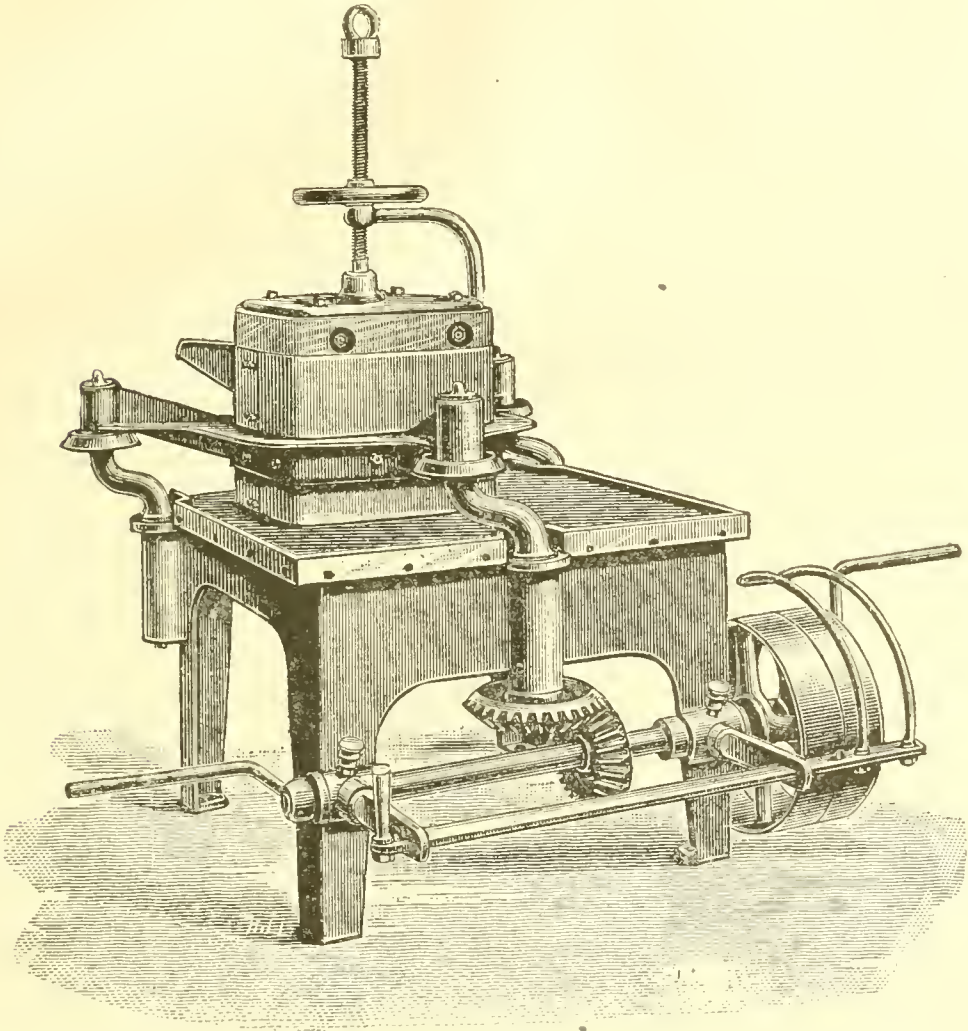


FIG. 2.—"Little Giant" tea rolling machine.

ground of the illustration of the lower story; it is broken up, bad leaf removed, and then spread on clean cloths on trays, which are exposed for oxidation to the action of the air in the frames shown on the left. When sufficiently oxidized, the leaf is "fired" in driers which are located in the middle room (fig. 3). The finished tea is then weighed and boxed for shipment (fig. 4).

The fruit evaporators made by the American Manufacturing Company have been most satisfactorily used at Pinehurst in drying tea. The moist tea is exposed to the highest temperature on the upper slides, and

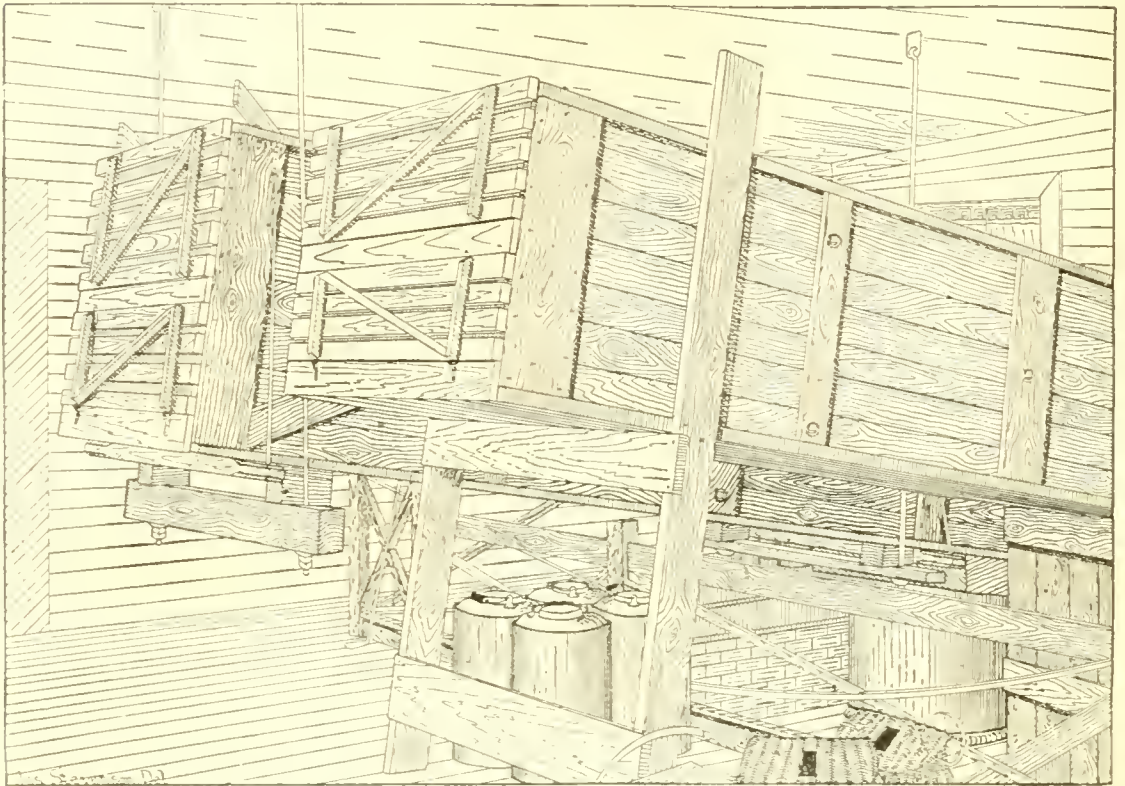


FIG. 3.—Drying machines for “firing” with hot air the rolled and oxidized leaf.

as it dries out it is gradually lowered to a cooler temperature, where it does not come in contact with escaping vapors—a great advantage.



FIG. 4.—Weighing and boxing finished tea: ends of driers in farther room.

DIFFICULTIES IN STARTING THE INDUSTRY.

Among the several difficulties which confront the establishment of this new industry in the Southern States, the following are the most important:

DEMAND FOR GREEN TEA.

(1) There is probably a greater demand in the United States for green than black tea. At present a large amount of sophisticated green tea is consumed in this country. As it is chiefly made of inferior leaf, highly colored with Prussian blue, and faced with powdered soapstone, etc., so as to hide all natural defects, it can not be regarded as either nutritious or healthful. But the nature of the demand indicates a decided preference for the taste and qualities of green, i. e., not oxidized, teas, and should stimulate us to supply in its stead a pure wholesome article of the same type. Unfortunately green teas can as yet be made by hand only; they represent cheap Oriental labor, and in the lower and medium grades competition by American manufacture is well-nigh impossible. Black teas can be made by machinery in almost every step after the delivery of the leaf in the factory.

COST OF LABOR.

(2) The cost of production of teas in this country is high, owing to the comparative dearness of labor. This must be met by a greater productiveness in the field; by the substitution of machinery for hand labor in the factory, and by the manufacture of varieties of teas which from inherent chemical causes can not be brought from the Orient.

As to a greater productiveness, one essential factor demands attention, viz, an abundance of the richest plant food, either natural or artificial. At Pinehurst the cost of enrichment by commercial manures amounts to $4\frac{1}{5}$ cents per pound of the dry tea from the older fields. The amount of production of tea and cost of artificial manuring are as follows:

Production, cost, etc., of tea growing at Pinehurst.

Name of tea garden.	Variety of plant.	Location.	Age of garden.	Extent of garden.	Production of green leaf—1898.	Production of dry tea—1898.	Production of dry tea to the plant in 1898.	Cost of commercial manure to the lb. of dry tea. ¹	Remarks.
			Years.	Acres.	Ounces.	Pounds.	Ounces.	Cents.	
Rose	A. H. ² ..	Drained pond...	9	0.82	21,701 $\frac{1}{2}$	323	5.57	2.3	Plants placed 6 feet apart.
Clay Hill	A. H.	Clayey hillside...	9	1.50	12,631 $\frac{1}{2}$	188	1.88	5.3	
Sand Hill	A. H.	Sandy level...	9	0.66	6,959 $\frac{3}{4}$	103 $\frac{3}{4}$	2.57	5.0	
North Bottom...	A. H.	Cleared swamp	9	2.66	22,069	328	1.78	3.9	
South Bottom...	A. H.	do	8	1.87	16,110	240	1.92	4.1	
South Fraser...	Chinese.	Mostly clayey hill.	6	2.00	20,653	308	1.00	5	Plants 4 feet apart.
Lincoln	Darjeeling.	Drained pond...	4	1.90	17,854	266	1.00	4	

¹ The fertilizer used contained 5 per cent available phosphoric acid, 5 per cent potash, and 5 per cent ammonia (chiefly from dried fish and red blood).

² A. H. refers to Assam-hybrid, mostly thoroughly acclimated tea, a cross of the Assam and Chinese sorts; and largely introduced into this country in the fifties.

As stated in the preceding table, based upon the operations of last autumn, the item of artificial manuring can be brought down to about 2 cents per pound of dry tea produced in a crop of over 300 pounds to the acre. By a suitable location on naturally very fertile lands the expenditure for manuring may be obviated, at least for some years, and a consequent saving of several cents per pound effected in the cost of production.

A greater productiveness per plant and per acre must lessen the cost of each pound of made tea, as it will reduce the distance to be traversed in picking the leaf. Incidentally it will permit for the same extent of gardens a reduction in the factory expenses, on the general principle that the greater the output the less the cost of the unit.

IRRIGATION.

Again, it will probably be possible to materially increase the productiveness of the tea gardens by irrigation. A comparison of the summer and annual rainfalls at Charleston with those of a number of prominent Oriental tea-growing districts shows that the latter receive not only a very much larger annual rainfall, but that the proportion which falls in the tea-growing period, from May to September, inclusive, is decidedly greater.

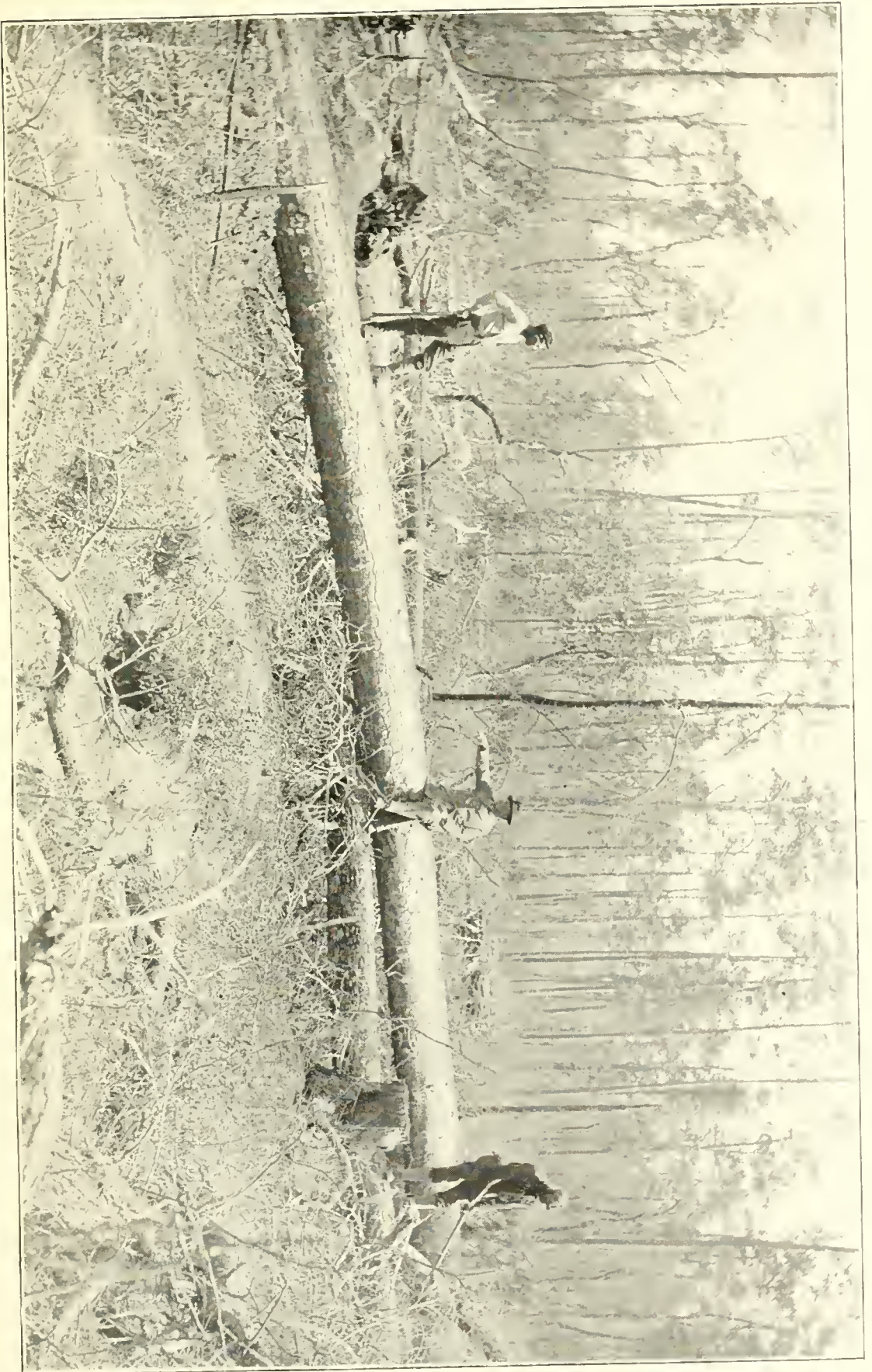
Comparison of rainfall at Charleston, S. C., with rainfall in India and China.

Locality.	Annual rainfall.	Rainfall May-Sep-tember.	Relation of latter to former.
	<i>Inches.</i>	<i>Inches.</i>	<i>Per cent.</i>
Charleston, S. C.	56.99	31.31	55
Goalparah, Assam.	94.44	80.39	85
Leedsangor, Assam.	90.45	66.48	73
Darjeeling.	129.50	111.06	86
Canton and Macao, China.	78.96	60.22	76

MAKING NEW GARDENS.

The work of establishing additional tea gardens for purely experimental purposes has progressed favorably. Under the auspices and with the pecuniary assistance of the U. S. Department of Agriculture the lands have been cleaned of the dense forest growth which originally covered them (PL. IX), thoroughly grubbed, and more or less leveled; treated with burnt marl at the rate of 1 ton to the acre to remove any sourness, and the preliminary steps taken toward supplying irrigation and subsoil drainage. The land has yet to be deeply plowed, and on the advent of the rainy season supplied with tea seedlings, of which there are many thousands in the nurseries. See Plate VI, figure 2.

This undertaking is, from the immediate surrounding conditions, necessarily expensive; but considering the otherwise favorable circumstances and the prime importance of the experiment, the results should amply repay the cost. In this section of the Southern States there are



CLEARING GANTT'S FIELD PREPARATORY TO THE ESTABLISHMENT OF EXPERIMENTS WITH IRRIGATION ON TEA GARDENS.

countless acres of rich lands, susceptible of irrigation, now only partially cultivated, which may be utilized for this new industry if the initial experiment proves satisfactory. And the recent evidence before the Industrial Commission reveals for many parts of the South a pecuniary remuneration of labor on the farm not so much above that of the Oriental laborer as was formerly believed.

The Pinehurst experience is that moist, well-drained, level land is the best for tea. How much increase in the crop can be obtained by artificial irrigation remains to be seen; as also how much water it is desirable to apply. M. Martin states (*Annales Agronomiques* XIII) that each plant requires about 13 gallons of water per week in the dry season. If planted at 5 feet distances, a garden of an acre would thus require 22,737 gallons weekly, or about four-fifths of an inch of water; and subsoil drainage is indispensable, even without any artificial addition to the water supply.

MOST PROFITABLE FIELD.

The best Oriental teas are said to be only slightly "fired," i. e., they are dried at low temperatures, to preserve those volatile principles which give them fragrance and delicacy of flavor. They will not bear distant transportation, if for no other reason, because they do not keep their best qualities for a long period. They are readily worth from \$5 to \$50 per pound in Japan and China, whereas the great bulk of the teas which we import from those countries costs less than 15 cents per pound at the port of shipment.

Twenty dollars a pound for tea means a dime or less for a cup of the beverage; but that price, strange as it sounds in this country, could not prove a barrier to the introduction of a grade of tea which would otherwise not be obtainable. Herein lies a most profitable, if limited, field for experimentation, because there can be no competition from afar.

And it may be suggested that perhaps the best avenues for success lie in the development of selection of long Pekoe tips for the manufacture of Mandarin tea, such as is made in China; and in the shielding of the tender leaf from the direct rays of the sun, as is done with mats in Japan.

A PLEA FOR AMERICAN TEA.

The following article, prepared by the author for the *Florida Times-Union*, and published by that paper in 1897, treats of tea at length, and it has been thought advisable to reproduce it in full in this report:

Commercial tea is made from the leaves of the *camellia thea*. Formerly, when it was erroneously supposed that black and green teas were necessarily made from different plants, it was attempted to distinguish scientifically between the varieties used in the production of each; for, although either sort may be made from the same leaf, experience will show that each variety of the tea plant is better adapted for the manufacture of the one or the other.

Practically it is desirable to separate as distinct varieties the two most divergent types—viz, the Assamese and the Chinese—from the many intermediate sorts which have resulted from their hybridization or are the result of climatic and other influences upon them.

It is claimed that the original tea plant is indigenous to Assam, a province in northeastern British India. There in the jungles of the Brahmapootra River, in a hot, steaming atmosphere, where frost is unknown, shaded by lofty subtropical forests, were found tea trees attaining a height of 25 or more feet, clothed with large, lustrous, bright-green leaves, measuring 9 inches in length and 4 in width. It is believed by many that all cultivated tea owes its origin to this source, and that when its utility to man was recognized it was thence carried to the north and east, even to the remote and chilly northern islands of Japan.

The result of this climatic change was to stunt the plant and shrink the foliage to the small, dull-colored, lancet-shaped leaves characteristic of the variety generally (but with some injustice) called Chinese.

Thus the tea plant, although originally from a subtropical climate, can endure very considerable cold, even brief periods of ice and snow, but at the expense of its size and, as we shall see, utility. The converse is also true—that varieties which have suffered from cold, neglect, and insufficient nourishment readily respond to more favorable conditions. The Pinehurst experiments have amply demonstrated this fact.

FAVORABLE CONDITIONS.

It is generally held that certain natural conditions of climate and command of cheap labor are indispensable for the success of tea culture. Among the former are a uniformly warm but not excessively hot temperature, one quite free from frosts, and an abundant rainfall, its copiousness being directly proportional to the intensity of the heat: and as hand labor plays an important part in the tea industry, necessarily so in the plucking of the leaf, the cost of labor demands careful attention. To which supposed essentials may be added the necessity of a deep, rich, thoroughly drained soil, since the tea plant requires the most abundant sustenance.

It will be at once suggested that a great and apparently insuperable disparity exists in most of these prerequisites between the Oriental tea countries and the Southern United States. It is true that almost all of the latter country is liable to frost and certainly by far the greater part to occasional ice; that the average rainfall is only half of that in India, and that the price of labor is several times greater. Nevertheless, there are, as we think, substantial reasons why tea should be extensively cultivated in this country.

MAY BE CULTIVATED IN THE SOUTH.

It is not necessary that the annual rainfall should exceed 60 inches where the average temperature is less than 70° F., especially if the greater part of the yearly precipitation occurs in the growing season. This is true of Japan, China, the higher altitudes of Ceylon, and some districts of India, where altogether the greater part of the world's tea is produced. And by a proper treatment of the soil, by underdrainage, subsoil plowing, and deep pulverization, a gain of moisture equivalent to a fall of 10 to 15 inches of rain is secured. This effect is enhanced by planting cowpeas between the tea bushes, whose roots penetrate the soil and dying not only leave valuable food for the tea, but render the earth much more porous and capable of retaining moisture during seasons of drought.

Frost and brief periods of cold curtail the production of tea; but some of the choicest brands, particularly those of great flavor, come from climates whose temperature often falls in winter below 32° F. A decided gain in quality compensates for a lesser yield in quantity.

The several tea countries exhibit a marked difference in the production per bush. Thus, in India and Ceylon exceptionally productive estates enjoy a yield of 8 to 10

ounces of dry tea per bush; the general average being 3 to 4 ounces, and at the higher altitudes 2 to 3 ounces. In China the bush is said to produce 2 ounces, but only by a system of plucking which approaches stripping. In Japan the yield is 1 ounce or less. At Pinehurst, with fine picking (ordinary picking should give fully 50 per cent more), the "Rose Garden," planted with thoroughly acclimated Assam hybrids, gave this year (1897) 3 ounces per bush; a garden of Chinese origin, four-fifths of an ounce, and one of Japanese, one-half ounce. It is observable how the effect of the native climate follows the seed into even distant lands.

Very many crops are remuneratively grown out of their natural zones, and often with an improvement of the quality, although usually at enhanced cost of labor and attention. This is strikingly shown in the case of tea, in the higher valuation of the product of the Darjeeling gardens in India, as also of the more elevated ones in Ceylon, and of the black and green teas from the northern district of China (the home of the *thea viridis*). The higher price of labor in this section should not prove an insuperable obstacle to the cultivation of tea.

DUTIES MAY BE RESTORED.

Temporarily the tea market is depressed, and immense quantities of the cheaper sorts are being thrown upon us, especially as we impose no duty on tea. The United States stands alone among civilized nations in the latter respect. Free-trade Great Britain imposes a duty of 8 cents per pound on the tea from her own colonies, and they furnish almost all that she consumes. The continental European countries place on tea duties of from 20 to 40 cents. Russia, which proverbially enjoys the best tea, charges the highest rate.

Some years ago, when the war between the States necessitated additional revenue, there was a duty on tea of 25 and later 15 cents per pound. To-day the revenue of the Government does not cover its expenditures, and consequently there is frequent discussion of the advisability of restoring the duty. An increase of 20 cents per pound is equivalent to one-tenth of a cent per cup of tea, since a pound of good tea should suffice for 200 cups of the beverage. A duty of 20 cents per pound would more than compensate for the difference in the cost of labor on the middling and low-middling grades, which without national protection in the form of duty or bonus it would be folly to attempt to raise on a commercial scale in this country. It is surely coming—the duty on tea—and just as surely as this Government will go on spending more than it collects. A war or any other cause for extraordinary expenditure must promptly reinstate it.

But aside from possible remunerative conditions not as yet existing, it will pay to raise the better grades of tea in the Southern States wherever the climate and labor best subserve the purpose. We fully believe that we have demonstrated that fact at Pinehurst. There may be more promising undertakings; there may be regions where ample and profitable employment is enjoyed by all, with a reasonable outlook for the immediate future; but the writer does not know where they are. On the contrary, the population seems to be increasing more rapidly than the means of employment and sustenance; and, without regard to the question of the currency, the day is almost upon us when many must be idle unless new industries are provided. The cultivation of tea offers easy outdoor occupation for men incapable of hard labor in a hot, malarial region; it enables women and children to earn their livelihood, as they are compelled to do in all thickly inhabited countries. It is not a case of "half a loaf." According to our experience, ordinarily skillful and industrious laborers may be safely paid as much in tea gardens as in cotton, corn, or pea fields.

WHAT MAY NOW BE DONE.

There is a large class of people who might profitably add the cultivation of tea to that of flowers and vegetables, filling out the corners of their gardens and home fields with tea bushes, as they do in China, or substituting useful as well as ornamental

evergreen hedges of that plant for the present unsightly and costly and frequently unreliable fences. Cultivated in this way, the outlay of time, labor, and money could hardly prove burdensome; and, as one result, the household should be able to supply its own tea—pure, strong, and invigorating, instead of the wishy-washy, often far from cheap, stuff generally sold throughout the country.

As these little tea gardens are extended and multiply, factories will be established in each neighborhood for the larger manufacture of commercial tea, whither the products of the gardens surrounding may be brought and sold, precisely as canning factories and dairies consume the surplus production of fruit and milk.

One feature in the cultivation of tea has only to be stated to appeal to everyone who plants, namely, that the season for gathering the leaf lasts in this climate for six months. Thus a crop is not dependent for at least partial success upon the weather of any one or two months, as is so apt to be the case with most of the objects of the husbandman's labor and solicitude.

For the present it will be wiser to limit the production of tea in the South to the better grades, such as retail at from 50 cents to \$1 per pound. The greater cost of unskilled labor in this country than in the Orient should constitute a smaller fraction of the total expense if the product commands a higher price. Other things being equal, the quality of any tea depends on the "fineness" of the leaf plucked. If only the tiny, tender, youngest leaf be picked, the quantity of the crop must be comparatively small: but its quality will be decidedly superior to that obtained by "coarse" plucking, which also embraces the older, larger, and necessarily tougher leaves.

A PLAN OF OPERATIONS.

In the selection of seed, it is desirable to procure the nearest approach to the Assam variety that the local climate will permit, if our object be to attain the greatest yield and strength consistent with quality; but it is to be remembered how exceedingly sensitive to cold is the indigenous Assam. If delicacy of flavor be sought, some of the Chinese or Indian hybrids will afford that, with a very fair leaf production. The intention of the grower to produce green or black tea will influence the selection of the seed. Here we have Assamese (at least some few that have survived the climate), Darjeeling, Kangra, Kumaon, Ceylon, Formosa, Chinese, and Japanese; also that Americanized stock which, from importations of many years ago (perhaps fifty), may be regarded as thoroughly acclimated. From all of these, except some Japanese, which we owe to that Government, and Formosan, better black than green tea can be made.

If foreign seed is desired, orders had better be sent to those who make a business of raising, selling, and shipping seed; otherwise there will ensue the natural disappointment from the loss of three out of four consignments, the consequence of ignorance and carelessness. The best seed comes from groves especially reserved for that purpose, and not subjected to the ordinary pruning and leaf plucking. The cost of 100 pounds Oriental tea seed, say 40,000 seeds, laid down here, will vary from \$60 to \$120, according to the quality and the expense of the transportation.

PLANTING THE SEED.

The sooner the seed is planted out, after maturing in the autumn, the better; and it is advisable to protect it in nurseries. Choose a thin, rather light soil, overlying a harder subsoil, with free drainage, near a spring or other water supply; spade the top soil to the depth of 6 inches; rake it off level; the surface should be rather below than above that of the surrounding land. Erect a frame and light cover of boards or boughs over the bed, as a protection from cold, but especially from direct sunlight. It should be sufficiently open to admit the rain. The underlying soil is left undisturbed, with the object of curtailing the growth of the taproot, which otherwise might suffer injury in the subsequent transplanting. Plant the seed 2 or 3 inches deep, at distances of 3 inches, in rows 4 inches or more apart; thoroughly wet the bed, and cover it with a few inches of pine straw or other litter.

If the rain be insufficient, thoroughly moisten the nursery bed, especially when the young seedlings begin to appear. Remove, then, almost all of the litter; keep the bed clean from weeds.

With the occurrence of the wet season in midsummer the seedlings should have attained a height of 4 to 6 inches, and are then ready for transplanting. This should be done with the ordinary strawberry transplanter. Good fresh domestic seed affords 75 per cent seedlings; but with importations from a great distance 25 per cent is a fair return, although we have occasionally germinated 60 per cent.

LAYING OUT THE GARDEN.

Select level land, naturally moist, but free from stagnant water; the soil should be light and porous, rich in thoroughly decomposed organic matter (preferably from oak leaves), and as deep as possible. The subsoil should be self-draining and present no obstacle to the deep penetration of the taproot.

Analyses of the best Indian tea soils show a great deficiency of lime, an absence of sulphuric acid, the constant occurrence of manganese, and a large amount of nitrogen, as also considerable quantities of potash and magnesia micas. The best Chinese, Japanese, and Javanese tea soils are said to contain a great deal of ferruginous clay, and to be likewise deficient in lime. The high quality of the Formosa tea has been attributed to the large content of iron in the soil. At Pinehurst experiments have been conducted on sandy, clayey, and bottom lands; on level fields, on hillsides, and in drained ponds, with the result that we earnestly recommend level lands thoroughly drained, porous to as great a depth as possible, and sweet, i. e., free from all virginal acidity. It was early recognized that none of our lands afforded sufficiently abundant and quick plant food to stimulate and maintain that unusually luxuriant growth which is indispensable in a successful tea garden. Consequently, all have received abundant enrichment. The chief question presented to us seemed to be whether a tea industry could be inaugurated here on a profitable basis, and minor considerations had to be postponed. The difference in the yield of the several gardens is to be attributed to the unequal productive habits of the different sorts and to the varying physical conditions of the lands. Nevertheless, as regards the former, it is noticeable how quickly the tea plant responds to generous treatment and returns full payment therefor in quantity and quality. With this increased vigor comes a tendency toward a type characteristic of the local climate; and, as a consequence, experts have appreciated and styled as "South Carolina" the flavor which belongs to the Pinehurst tea.

It has been found desirable to plant at greater distances than is common in the East, so that draft animals and the usual cultivators may be substituted as far as possible for hand labor, such as obtains in cheap-labor countries. Tea is usually planted in rows. The plants may be at distances of 4 feet or more, according to the size of the kind, laid out rectangularly or by alternate planting ("quincunx"), as used in some Florida orange groves, whereby three-way plowing is secured, or hedges may be formed by planting at 12 to 18 inches apart, with alleys of 5 or more feet between them. The latter system involves more hoeing, but can be advantageously used on slopes, to prevent the washing away of the soil. We have also planted seed "at the stake;" that is, where the garden is to be formed and the tea bushes to stand, but the nursery method is preferable.

Each seedling should receive the protection, from the sun and cold winds, of two shingles; in summer they are placed to the south and west and in winter to the north and west.

CULTIVATION.

Keep the young plants growing by any and all good agricultural methods, otherwise leave them alone, unless it be to pinch back any excessive upward growth. As a rule, it will be well to defer any excessive leaf plucking until the third year; nevertheless we have made about 50 pounds of tea to the acre from 2-year-old gardens

without detriment. Vacancies caused by the death of individual plants should be filled as early as possible from surplus stock left in the nursery.

The manures employed at Pinehurst are carefully preserved stable compost (fortified with acid phosphate and kainit) wherever it can be profitably utilized, and commercial fertilizers rich in soluble potash and available nitrogen, with a modicum of soluble phosphates. New land gets with us a heavy dressing of burned marl in advance of cultivation. The tea plant demands the richest of food and plenty of it. In the autumn cowpeas are sown in the alleys.

THE CROP.

Leaf-plucking demands the careful attention of the tea grower. It is a light employment, suitable for women and children, but they must be patiently taught, and their work must be strictly scrutinized. At Pinehurst colored children do the picking, and very satisfactorily. A free school (Pl. VII, fig. 2) is maintained for them; every pupil of suitable age and size is required to pick; others are excluded from the gardens. Regular attendance and better discipline are thus secured. But, otherwise, there would be no difficulty in securing an ample force, as the wages earned prove in themselves a sufficient attraction. The older children earn from 30 to 50 cents a day; the younger ones in proportion. During the past season the tea gardens were picked twenty times, or once every ten days, and it took three days for the average force of twenty children to make the round of the gardens. The more industrious and skillful pick from 10 to 20 pounds of fresh leaf per diem. It takes $4\frac{1}{2}$ pounds of fresh leaf to make 1 of dry tea.

FLUSHES.

The growing tea plant throws out from its branches tender, bright shoots. On examination these are found to consist of a tiny, tender, unexpanded leaf bud at the end of the shoot (the so-called Pekoe tip, or flowery Pekoe); an almost equally tender, small leaf follows on the stem (the orange Pekoe), and then one slightly larger and firmer (the Pekoe). The bud and two leaves furnish Pekoe tea. Following them come two yet larger and more mature leaves, the first and second Souchong; and the twig has often two more still.

In the axis of each leaf, that is, between it and the stem, may be seen a diminutive leaf bud, which, on proper encouragement, will rapidly produce another wholly-equipped shoot. This encouragement is afforded by furnishing such a stimulus to luxuriant growth that its existent foliage fails to meet the demands of the plant, or by artificially depriving it of the greater part of its leaves. These new shoots constitute a "flush;" and as each shoot has several leaf buds, it will be seen how rapidly the work of restoring the natural equilibrium can proceed.

The cultivated Assamese variety is capable of bearing twenty or more flushes in the season; the Chinese and Japanese, only a few. On young plants and with the earliest spring flushes of older gardens the pickers are taught to nip off between the thumb nail and forefinger the Pekoe tip and three-quarters of the orange Pekoe leaf. As the season advances and more leaf may be safely picked, three-quarters of the Pekoe leaf are additionally taken. Thus two leaf buds are left at the end of the shoot for producing others in due time. At the height of the season we sometimes pluck three-quarters of the first Souchong, if quite tender.

This constitutes fine picking; hence the strength and flavor of the Pinehurst tea. In other countries both of the Souchongs are usually picked, and in China, at the summer crop, almost all, if not quite all, of the young shoots is taken.

The children put the leaf into Swiss trout baskets. They are not permitted to pack it down tightly, for fear of its becoming heated. Nor is it allowed to collect in large quantities in the field, but is brought to the factory, very carefully examined as to fineness and general condition, weighed, and spread out on a cool, clean floor.

PRUNING.

When the tea bush has lost its youthful vigor, when the intervals between the flushes are protracted, or the growth has become too tall and irregular, perhaps entangled, then pruning becomes necessary. This step consists in the moderate or occasionally rigorous cutting back of the foliage, so as to force a long succession of flushes. It should be done in the winter, and a bush severely pruned at that time should receive only mild picking during the ensuing spring and early summer. The production of leaf on even the most luxuriant types of tea is but scant if they be left to themselves in their native jungles, whereas if introduced into the open sunlight, and properly pruned and cultivated, they become capable of an enormous yield. Nor does intensive cultivation and cropping, judiciously exercised, appear seriously to impair their strength and life. The importance of this step was quickly appreciated by that veteran horticulturist, William Saunders, of the National Department of Agriculture, on his official inspection of the Pinchurst tea gardens during the past summer. In his report to the Secretary of Agriculture he wrote:

"The first garden visited at Pinchurst in company with Dr. Shepard was one of about 2 acres in extent, where the pickers were busy collecting a 'flush.' Having grown many thousands of tea plants, and being familiar with methods of culture in India, so far as verbal information from growers and illustrations could convey ideas of management, the writer saw at first glance that he was looking upon a tea garden of perfect cultivation. The first attraction of such a garden is the remarkable color of the foliage, a deep, velvety green, shining with vigorous health on the lower leaves of the plants. The uniformity and perfection of shape of the plants, indicative of skillful pruning, is next noticeable. Skill in pruning is also apparent in the vigorous growth of the young shoots, giving succulency to the leaf and promoting rapid development of continuous flushings. All these features combine to form a scene of uncommon interest of the appreciative observer.

"No single operation in the management of tea gardens at Pinchurst is more interesting to a practical plant grower than the system of pruning. This has been reached after a long study of various methods, some of which have proved disastrous.

"Here the pruning is directed first to the gradual extension of the breadth of the plant without greatly increasing its height, but increasing the number of shoots available for picking; and, second, to secure strength in these shoots, so that their vigor is maintained up to the last flush, and they are able to respond quickly in the production of new leaves after each picking."

MANUFACTURE.

There are very many commercial teas. Prominent and most divergent are the so-called green and black: the intermediate ones are numerous. Two processes are requisite in the manufacture of all teas, viz, rolling or other manipulation, whereby the leaves are preserved and the oily cells in the leaves are broken and their contents rendered easily extractable by hot water, and drying, whereby the tea is preserved. In the manufacture of green tea these operations suffice, and they should be performed with celerity, so as to prevent the action of the atmospheric oxygen upon the leaf. In making black tea two additional steps are necessary, viz, withering, whereby the leaf is prepared for rolling, and oxidation (formerly thought to be a fermentation), whereby certain chemical changes are induced. It is not intended to enter upon the description of the manufacture of tea in this article, already perhaps too long. There will be abundant time to thoroughly study and provide for its various operations before the tea plantations, which the writer hopes to see started in Florida, are ready to furnish leaf. That he is a firm believer in the future, if not the present, of American tea his 50 acres of tea gardens attest.

CHARLES U. SHEPARD.

PINEHURST, SUMMERVILLE, S. C.

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